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SCIENCE

Vol. 104, No. 2707 Friday, 15 November 1946

Semantic Choice and Personality Structure

Florence L. Goodenough

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MAN IS A RECEPTIVE CREATURE. Not only is his body equipped at every point with sensitive nerve endings by means of which physical events are transformed into nerve action, but he is further provided with a muscular system that enables him to bring himself into active contact with a wide variety of objects and events. Thus, in part through the inevitable conditions of living and in part as a result of his own purposeful activity, he is constantly bombarded by an unending series of external forces which impinge to a greater or less degree upon his sensitive organism.

He is also a retentive creature. Like footprints in moist clay, the experiences through which he passes in the course of his life leave their impression upon the structure of his personality. But because man is, first of all, an active creature—a living organism for whom contact with the environment means a constant sequence of metabolic interchange, both physiological and psychological—such an analogy cannot be pushed too far. Certainly the form and pattern of man's personality is not merely the passive result of the environmental strains and stresses through which he has passed. Not only does man leave his own footprints on the sands of time, but the imprints which the external world makes upon him are continually being subjected to internal pressures and strains arising from the changes incident to his own growth and development and to the accumulation of new experiences which overlie and modify the traces left by previous events.

It is this active and dynamic interchange between the self and its surroundings which lends to an individual's impressions of former events their chief importance as indicators of personality characteristics. If external happenings were merely to leave an exact and factual record of their overt characteristics upon the mind of the person who experiences them, a study of such records would have little more than historical significance. It is just because mental impressions are not simple reproductions of the events which gave rise to them but, on the contrary, have been restructured, reorganized, elaborated, or simplified in conformity with the character of the experiencing individual that their later contour becomes worthy of serious investigation by the psychologist. Within limits, at least, the psychological interest in such impressions increases in proportion as their factual accuracy diminishes.

Since the days of Jung it has been recognized that the nature of these reconstructed memory traces may be explored through the medium of free associations to common words. The use of word association tests in clinical practice was given a certain degree of statistical precision by means of the standardized frequency tables compiled by Kent and Rosanoff (*4*), who demonstrated that mentally disturbed persons who are finding the real world so difficult or unsatisfying that they attempt to withdraw into a universe of their own contriving are likely to give an excess number of responses not included in the standard lists but suggested by their own individual problems and fantasies. Many other diagnostic signs were noted by these authors and others.

Most of the studies of word association carried out up to the present time have aimed chiefly at devising methods for clinical diagnosis. Behavioral manifestations of one kind or another are noted in connection with responses to particular stimulus words, and these leads are followed up in an attempt to uncover the meaning of such deviant responses in terms of the specific associations which gave rise to them.

That studies of this kind have been, and will continue to be, of decided clinical usefulness there can be no doubt, nor can the fact be questioned that important scientific information has been gained in this way. But there is another aspect of the matter which thus far has been much less thoroughly explored. It is reasonable to suppose that the restructuring of remembered experiences by the individual is not

Vice-presidential address delivered at St. Louis, 28 March 1946, before the Midwestern Psychological Association, meeting in collaboration with Sections I and Q, AAAS.

merely a fortuitous activity, but the resultant forms and patterns are in large part determined by the subject's individual personality. It seems altogether likely, therefore, that not merely those responses which are so bizarre or unusual as to attract the attention of the experimenter but also the particular pattern of associations which fall within the normal or usual range may have diagnostic significance with reference to the broad aspects of personality which have resulted from the continuous assimilation of new experiences by a growing and changing organism.

This idea is, of course, not new. As early as 1925 Wyman (*11*) made use of the free association method in the development of a group test for school children which was designed to measure three kinds of interest, designated by her as "intellectual interest," "social interest," and "activity interest." More recently, Terman and Miles included a controlled association test in the multiple choice form as a part of their test for the measurement of mental masculinity and femininity. Maller (*6*) has constructed a test of the same type but using only two alternatives for the measurement of neurotic tendencies. A number of other investigators have experimented with both free and controlled association as a device for the appraisal of personality or for the study of thought processes.

Although it has been generally realized that the choice of stimulus words will have an important bearing upon the results obtained, relatively little has been accomplished in the way of developing an objective criterion for the selection of a suitable list of words for general use, even though the advantages of working with a standard list for which a dependable table of response frequencies has been prepared are well recognized. Undoubtedly, one of the reasons for this seeming neglect is the fact that few people are wholly aware of the importance of a thoroughgoing knowledge of the range of responses to each stimulus word used if errors of interpretation are to be avoided. The distribution of responses for groups varying with respect to such factors as sex, age, education, and social background is likely to differ considerably, even for the most commonly used English words. For this reason, a single frequency table in which the responses of all available subjects are thrown into one common distribution can serve only a limited purpose, but for the same reason a comparison of the results obtained for contrasted groups, selected on the basis of some known differentiating factor, may yield exceedingly valuable information.

If word association tests are to be used for the study of individual or group differences, two criteria for the selection of stimulus words are of prime importance: (1) the words must be simple, falling well within the everyday vocabulary of all those with whom the test is to be used, and (2) each word should tend to elicit responses of strongly contrasted meaning that lend themselves readily to classification. The first criterion can be met reasonably well by comparison with such a standard source as the Thorndike Word List. Some years ago it occurred to me that an excellent approach to the second might be made by confining the choice of stimulus words to homographs—words which, in their written form, have two or more different origins and consequently two or more well-contrasted meanings. Under pressure of instructions to work as rapidly as possible, the subject is rarely conscious of more than one possible meaning for such a word. His choice is made automatically and for the most part without awareness that choice is involved.

Take, for example, the word "ring," which may refer either to an article of jewelry or to the sound of a bell, or, somewhat less commonly, to other circular objects or to abstract shape. In addition, for a small group of persons, chiefly males, the most prominent association has to do with sports such as boxing, while with some women, for the most part those who have a good deal to do with the ailments of children, the word promptly elicits the response "-worm." Literary associations such as "and the book" or "Niebelungen" occur occasionally, and other rare but entirely comprehensible associations will be found in practically any sample of moderately large size.

These are the main categories under which at least 95 per cent of all the responses of an ordinary group of English-speaking subjects can be classified. Subdivisions within these broad groupings can also be distinguished with but slight falling off in reliability of placement. Within the jewelry category, for example, one may note a distinct difference in feeling tone between such comparatively impersonal and matter-of-fact associations as "ring—hand" or "ring—finger" and the more intimate note sounded by "ring—wedding," "ring—engagement," or the still more personal "ring—from Jim." Even more remote than the references to hands or fingers are the not infrequent associations with materials or settings such as "ring—gold" or "ring—sapphire." In like manner associations clearly referring to sound admit a number of subdivisions. There are references to sound in the abstract, as "ring—noise" or "ring—clang." There is the relatively nonspecific "ring—bell." There is the social or business reference, "ring—telephone," or the more exclusively social "ring—door" or "doorbell." There is the definitely active "ring—up" and the more passive "ring—rang."

That the unconscious reading of one or another of these contrasted meanings into a word to which any of them may apply is not merely a circumstantial

matter changing from moment to moment is attested by a number of facts. First, the responses of the same person to each of a series of over 200 words of the homographic type are internally consistent. The consistency is not always apparent to one unacquainted with the underlying pattern of personality and its expression. I doubt that many persons would predict that persons whose response to the word "ring" is "finger" or "hand" are about three times as likely to associate the word "wind" with "rain" as are those whose response to the word "ring" is "bell." I have no very plausible explanation for this, but it has proved to be true in a number of different populations. Neither am I able to say why "ring—finger" and "wind—rain" should be tied in with "kind—good," while "ring—bell" and "wind—storm" are more likely to go with "kind—gentle," but this is also the case. Not only is there this internal consistency but tests repeated after an interval of a year or more show a high degree of correspondence with respect to the classes of response given on the two occasions. Finally, there is the fact that groups selected on the basis of some external criterion exhibit recognizable patterns of response that distinguish them from other groups of different composition.

Observation of this fact led to the hypothesis that free associations to stimulus words of the homographic type may provide unusually rich material for the study of personality differences. The work of Terman and Miles (*10*) on mental masculinity and femininity suggested that a study of sex differences in response to a list of such words would provide a suitable test of the extent to which these unconscious choices among concealed alternatives may be regarded as signs of an underlying pattern of personality structure.

The results of the first study have already been reported (*2*). In this investigation responses to a list of 240 stimulus words of the homographic type from a sample of 800 high school and college students equally divided as to sex were tabulated separately and a weighted scoring key was derived on the basis of the reliability of the sex differences as indicated by the magnitude of Chi-square. By means of this key the responses of an individual subject could be scored for mental masculinity or femininity by a procedure similar to that employed by Terman and Miles.

When judged by the usual criteria, the results obtained by this method appeared at first to be reasonably satisfactory. The sexes were clearly separated with only a small percentage of overlapping. Internal consistency as indicated by the correlation between odd- and even-numbered items was approximately +.80 for single-sex groups and well over +.90 for groups including both males and females. Nevertheless, as data were accumulated it became increasingly evident that something was radically wrong. The nature of the difficulty could be summed up in a few words. The "feminine" man is not the same kind of human being as the feminine woman, nor is "masculinity" in women truly comparable to masculinity in males. There are enough surface resemblances to suggest a name for the trait, but the basic qualities are different. Since this was so evidently true, the use of a common key for scoring the responses of both sexes seemed a questionable practice. A second key or, more precisely, two keys were therefore constructed by the same method used in deriving the first except that the groups compared were the top and bottom quartiles of single-sex distributions of cases which had been scored according to the first key. The two keys thus derived necessarily bear some resemblance to each other and to the first key, but there are also many differences between them which follow a sufficiently consistent pattern to be of some psychological interest.

When reference is made to an activity that is decidedly more common in one sex than in the other, the key for the sex of which the activity is characteristic usually shows a sharp differentiation in the weights given to responses taking the form of active verbs as compared to those for participles ending in *ing* or to the past tenses ending in *ed*. For the sex less often participating, however, no such differentiation in score value usually appears. For example, the stimulus word "rod" elicits from both sexes a good many references to fishing, but in the case of males, those whose total scores fall in the top quartile for masculinity are so much more likely than are those with scores in the lowest quartile to respond with the active verb, "fish," that on the basis of the Chi-square criterion "fish" receives a weight of 4M on this key while "fishing" gets a weight of only 1M. In the case of women and girls, however, no such differentiation between the active verb and the participle appears. Both forms are given somewhat more often by the less feminine than by the more feminine end of the distribution and so receive a weight of 1M, but the sharp cleavage between the active and passive references that is marked for the males is not apparent among females.

When we come to words that refer to a typically feminine activity, the picture is reversed. An example is seen in the word "yarn," which elicits from both sexes a good many references to knitting. Here the sharp distinction between the active verb and the participle is seen in the key used for females for whom the response, "knit," gets a weighting of 4F while "knitting" is weighted only 1F. Again there is no differentiation between the two forms of the verb when given by males. Both receive a score of 1F.

Results such as these strongly suggest that the extent to which an activity has become a part of the life pattern of an individual, welded, as it were, into the very structure of his personality, is indicated not only by the fact that he has formed associations about it but even more strongly by the fact that these associations are related to the concrete performance of the act and not merely to acquaintance with it in a more abstract or remote sense. We fish or we talk about fishing; we knit or we see other people knitting. The one is active, forceful, dynamic; the other is passive, remote, desultory.

Further evidence as to the differential significance of the active verb and the participle is obtained from a second study using the same list of stimulus words. The purpose of this investigation was to ascertain whether or not qualities of leadership are revealed in the free associations of typical adults. Through the cooperation of Col. Hobby the association test was given to approximately 1,000 women in the first Officer Candidate School of the Women's Army Corps, at that time known as the Women's Army Auxiliary Corps. Because of the unusually great care taken in the selection of candidates for this school to secure only women with high leadership ability (*3*), the group chosen seemed likely to provide exceptionally good material for studying this question, at least as far as leadership in women is concerned.

For comparison with the results obtained for the officer candidates, a second sample of approximately 1,000 WAAC privates was also tested. A scoring key for leadership in women was then prepared by the same method as had been used in deriving the M–F keys, using as the basis for deriving the weights the difference between the responses of 500 officer candidates and an equal number of privates matched with the officer sample for age, residence, marital status, and occupation before enlistment.

The proportion of active verbs among the associations given by the officer candidates was many times greater than that given by the privates. This tendency was so marked throughout the entire list of words that it frequently, though not invariably, outweighed the choice of semantic category in determining the leadership score. Tabulation of the weights given in the key indicates that the chances are almost 10 to 1 that a response which is an active verb will be weighted in favor of leadership while, conversely, a response in terms of a participle ending in *ing* has not more than 1 chance in 20 of receiving a positive weight. All this leads to the conclusion that the leader is the doer—the one whose primary associations are with actions and not merely with activity in the abstract.

It was noted earlier that, although the two scoring keys for appraising mental masculinity or femininity in males and in females, respectively, are correlated with each other, they differ markedly in a number of respects. In some cases this difference is so great that the score for the same response may even take opposite directions in the two keys. Of particular interest are those cases in which the score in both keys goes contrary to the sex of the respondent, the same response receiving a feminine weight when given by males and a masculine weight when given by females. An example is "scab—blood," for which women receive a score of 1M and men a score of 1F. Other instances of this class are "kind—mean"; "ease—sickness"; "lock—shut"; "can—cannot"; "stick—stuck"; "skip—school" and "skip—miss"; "coast—clear"; "hard—difficult"; "kick—in pants" and "kick—person"; "block—blockhead" and "block—obstruct"; "firm—harsh"; "blow—hard"; "drop—cough." With very few exceptions the list just given appears to suggest some degree of maladjustment.

In marked contrast are the associations for which the weights in both keys correspond to the sex of the subjects. Examples are: "gas—car"; "note—book"; "party—dance"; "case—cokes"; "date—sweetheart" and "date—party"; "dear—mother"; "stage—play"; "strike—baseball"; "coach—athletics"; "dressing—dance"; "cheer—leader." Although many of these responses are rather innocuous, not one appears to suggest the morbidity, resentment, or discontent typical of those in the first list. In general they suggest a healthy preoccupation with the normal activities of young people and a cheerful, contented outlook upon life.

The contrast between the two lists warrants the inference that marked nonconformity with the habits of thinking characteristic of the group to which one belongs is likely to be associated with personal unhappiness or social difficulties. The difference also provides further evidence that the terms "masculine" and "feminine," when applied to the sex which they do not normally characterize, are at most only partially appropriate. The interests and attitudes displayed by the two sexes are too deeply rooted in nurture, if not in nature, to be displaced without risk of damage to the entire personality structure.

Certain trends, however, appear to be characteristic of "masculinity" or "femininity" regardless of the sex of the person who displays them. It will surprise no one to learn that references to mechanics or mechanical processes usually, though not invariably, receive a masculine weighting in both keys while references to domestic activities, clothing, or cosmetics are likely to be weighted in the opposite direction. References to food and particularly to sweets are also much more frequent at the more feminine ends of both the

male and the female distributions. Males more often respond in terms of opposites and adverbial completions than do females while the latter are more inclined to use synonyms and descriptive adjectives. A similar trend appears at the corresponding extremes of both sex distributions.

Interesting, also, is the correlation between the total M-F score and the number of overt references to people. We have classified under this head only such nouns as clearly refer to human beings, such as "man," "woman," "blacksmith," "person," and so on, together with their plurals. In 1922 Moore (*7*) called attention to the greater frequency of references to persons and personalities by women as compared to men found in the snatches of talk overheard by an observer stationed at a busy street corner in New York City. A similar procedure was followed by Carlson and his associates (*1*) in the lobby of the concert hall during intermissions of the Minneapolis Symphony Concerts with similar results. McConnon (*5*) carried the procedure to the five-year-old level, using the free-play period in a number of Minneapolis kindergartens. Although the sex difference in the number of remarks having to do with people was less marked than those established for adults, it was in the same direction and was large enough to be significant at the 1 per cent level of confidence.

In all these studies the comparison was made between individuals who actually differed as to sex. It is the more interesting, therefore, to find that the free associations of persons of the same sex but differing with respect to the M–F score obtained on their total list of responses show a similar trend. For example, when a count was made of the number of nouns referring to human beings among the responses of a group of 100 adult women and the results tabulated according to the total M–F score, the means for the successive quartiles from the most to the least "feminine" were as follows: top quartile, 17.5; remaining three, 10.5, 7.5, and 6.0. Even more striking are the figures for extreme counts. In the most "feminine" quartile, 37.5 per cent had counts as high as 20 while no one in either of the two lowest quartiles reached this figure. Of those in the most "feminine" quartile, only 25 per cent gave fewer than 10 responses of this class while in the lowest quartile 96 per cent of the scores were below 10.

Tabulations for a group of male subjects showed a similar trend, although the difference was less marked. The comparative lack of discrimination in males arises from the small number of very high scores, which reduces variability at the upper extreme, while the fact that a few words in the list elicit references to human beings in a large percentage of cases of both sexes makes it rather unlikely that any score will fall below 3 or 4. However, in spite of the marked reduction in range, it was found that means for successive quartiles arranged in order from highest to lowest masculinity were as follows: 8.6, 10.1, 10.9, and 12.4. In this group only 2 of the 100 subjects had scores as high as 20.

The relation of masculinity or femininity to factors in the life of the subjects is a fascinating but complicated problem. A number of intrafamily relationships have been noted, and other studies in this field are in progress. A recent study by Smith (*8*), in which the association test was given to a group of university girls and their parents, yielded correlations of + .26 between scores of mothers and daughters and – .33 between those of fathers and daughters—that is, there was a small but reliable tendency for the most feminine girls to have the most feminine mothers and the most masculine fathers. There was also a slight tendency, at least within this group, for the most masculine husbands to have the most feminine wives. Whether this relationship is a matter of marital selection or has arisen from the give and take of marital life cannot be determined from the data at hand, since most of the couples had been married to each other for around a quarter of a century at the time the test was taken. When a midparent score was obtained by averaging the scores of husband and wife without regard to sign, the correlation with daughters' scores was + .40.

Using the M–F key derived from the Strong Vocational Interest Blank, Terman and Buttenwieser (*9*) made a special study of the masculinity–femininity scores of happily and unhappily married couples and of couples who had been divorced. An outstanding finding was the very high masculinity score of the divorced women. I have compared the scores on the association test of divorced, married, and single women, matched for education, age, and occupation. One hundred cases were included within each group. The range of ages was 21 to 44 years. For purposes of comparison the cases were divided into two age groups of 50 sets each, those of 32 years or older constituting the older group and those under 32 comprising the younger group.

Among the older group the number of divorced women making definitely masculine scores was reliably greater than that for either the single or the married women, the difference being significant at the 2 per cent level of confidence in both cases. Among the younger women the difference was in the same direction but not large enough to be reliably established. Possibly the fact that more subsequent changes in marital status are to be expected among this group accounts for the smaller degree of differentiation.

It is interesting to note that the group of divorced

women also includes a greater number of cases with very high feminine scores than either of the other groups, in addition to the excess of masculine scores. The difference is small but in the same direction at both age levels. Possibly the woman whose interests are too exclusively of the feminine pattern, who has not enough admixture of masculine interests to permit real companionship, may be as poor a risk in marriage as the one who competes with her husband for the masculine role.

That stability in marriage may be an indication of stability in a broader sense is suggested by the definitely smaller number of rare responses given by the married women. Practically all investigators have agreed that the occurrence of an exceptionally large number of unusual responses is frequently associated with some form of mental or emotional disturbance. We have classed as "rare responses" those given by fewer than .5 per cent of the 800 cases used for standardization. Tabulation of the frequency of such responses for the three marital groups shows a marked preponderance of very high scores among the single women and the divorced, with relatively few among the married group. Whatever may be the factors lying back of these high scores, they at least seem to be much less frequent among married women than among those who have either failed to marry or whose marriages have been unsuccessful.

The past few years have witnessed a striking shift in the techniques employed for the appraisal of personality differences. Earlier studies in this area were dominated almost completely by the theories and methods that have proved so useful in the measurement of ability. For the most part these are sampling devices. Gradually we have come to realize that there is a fundamental difference between ability and attitude which is of basic consequence for the problem of measurement. In the case of ability, the universe to be appraised is, as a rule, overt and readily accessible. Few people insist upon hiding their talents and skills in a napkin. The method of sampling is therefore well suited to the purpose at hand, the major problems arising from lack of agreement among workers as to the limits of the universe and uncertainty as to the best means of obtaining an adequate and representative sample of it. But when we come to deal with what is often called the "private world" of the individual, comprising, as it does, the feelings, urges, beliefs, attitudes, and desires of which he may be only dimly aware and which he is often reluctant to admit even to himself, much less to others, the problems of measurement are of a very different nature. Here the universe which we wish to assay is no longer overt and accessible but covert and jealously guarded. Thus, the methods of direct sampling become hazardous since an unbiased sample is so difficult to secure.

Recognition of this difficulty has led modern students of personality to a search for signs rather than samples. The devices employed in the hope of eliciting signs by which the inner life of the individual may be unconsciously revealed are often grouped together under the heading of "projective methods." The Rorschach ink blots and the Thematic Apperception Test are among the better known examples of this class. An outstanding advantage of these methods is the fact that, because the task which is set the subject is relatively unstructured, he is free to respond in whatever way seems to him to be most nearly right and meaningful. Since no set scale of answers is provided, the only suggestions given are those arising from his own individual interpretation of the situation in the light of his experiences and attitudes. While this freedom of expression makes for many difficulties in scoring, the time and effort expended should be well worth while in view of the greater potential value of the material obtained.

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The Production of Ice Crystals in a Cloud of Supercooled Water Droplets

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A STUDY OF ICE CRYSTALS and "ice nuclei" has been under way in this Laboratory for some time with the purpose of investigating some of the basic problems related to the icing of aircraft and other cold-weather phenomena. Recently several experiments have been made with supercooled clouds of water droplets which are interesting and seem worth while to report.

In the experiments to be described a supercooled cloud is formed by introducing moist air into a small, commercial freezing unit having a rectangular well 60 cm. long, 45 cm. wide, and 50 cm. deep. In many instances it is possible to carry out the experiments with the top of the unit uncovered because of the stability of the cold air in the well. This forms a typical temperature inversion with the coldest part of the air at the bottom of the chamber. Under typical laboratory conditions with a room temperature of 27° C., the temperature of the air in the center of the cold chamber is maintained at about −15° C. with the temperature −20° C. at the bottom and −10° C. near the top.

During more than a hundred experiments observed up to the present time, all supercooled clouds formed in the cold chamber have never developed into ice-crystal clouds except under conditions which will be described. Thus, with all of the various types of dust particles normally present in a research laboratory, besides those which would be added by the close proximity of many manufacturing processes, nothing served to initiate the crystallization of the supercooled cloud in the cold chamber. Under normal conditions in the chamber, the cloud persists for periods ranging from 4 to 10 minutes, the life of the cloud depending primarily on the evaporation and diffusion of the water droplets onto the ice-coated walls of the well. In addition to permitting these various types of "commercial" dusts to enter the cold chamber, many ex-

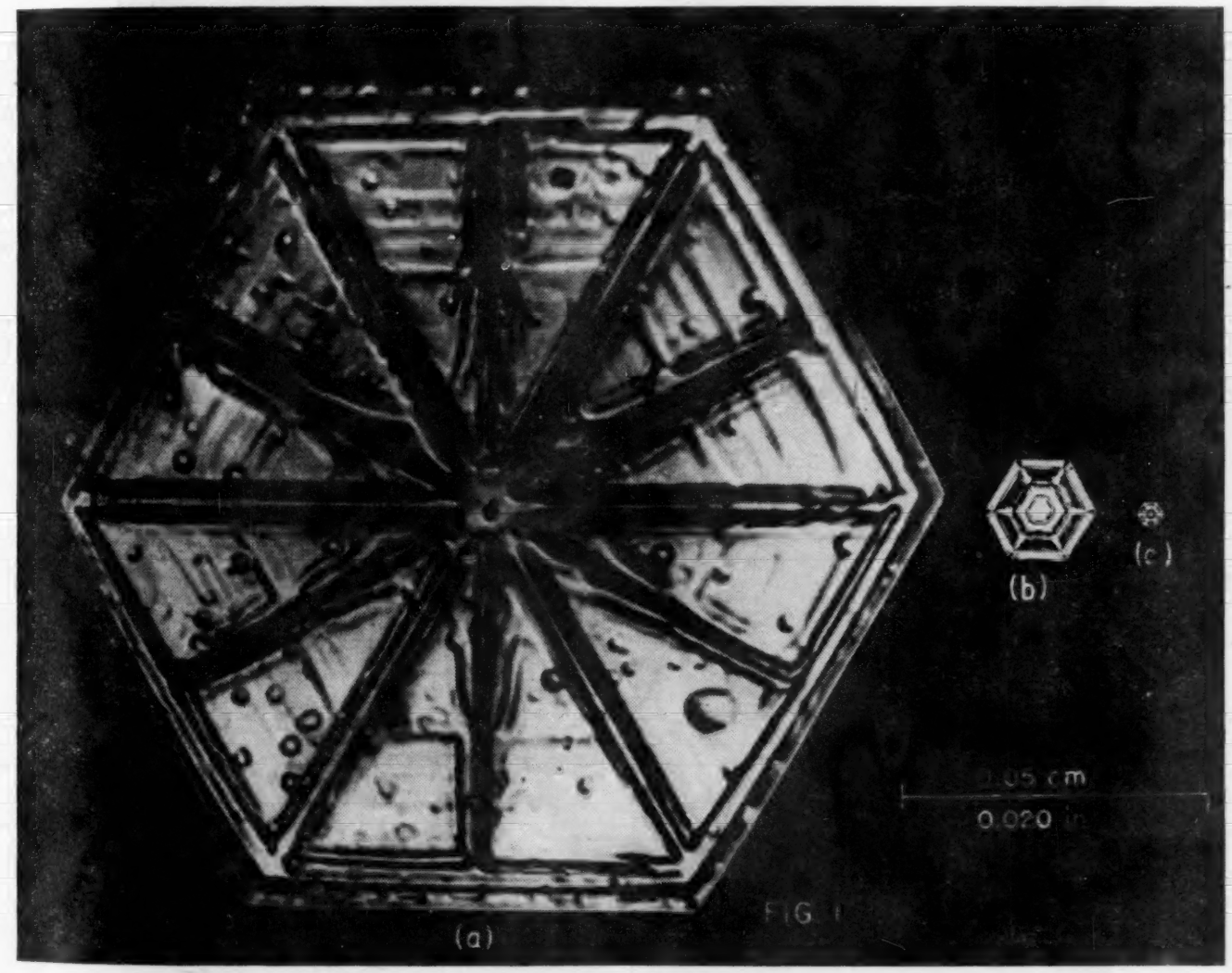

FIG. 1. Photomicrograph of (a) crystal in ordinary snowstorm; (b) type in cirrus cloud; (c) "diamond dust" crystal.

periments were conducted in which samples of various types of fine particles were intentionally added to the supercooled cloud. Carbon, graphite, oil, sulphur, magnesium oxide, volcanic dust, talc, silicates, silica, diatomaceous earth, and many others were introduced as aerosols in an attempt to force the supercooled droplets in the cloud to crystallize.

By using a collimated beam of light from a 32-c.p. lamp in the cloud, the presence of a single ice crystal in the light path is easily observed. Water droplets in the size range of 5–20 μ, such as develop in the experiments described, scatter light mostly in a forward direction. At the same time, a typical water droplet corona can be seen if the lamp housing is removed. An ice crystal, however, due to its crystalline angular faces, scintillates in the light as it tumbles about in the air and reflects light in all directions.

After undertaking many experiments in an attempt to form ice crystals in the supercooled cloud, a piece of solid carbon dioxide (dry ice) was placed in the chamber. Within less than 10 seconds the supercooled cloud was completely converted to one of ice crystals! The introduction of additional water droplets to the cloud only served to make the ice crystals grow, since the vapor pressure of supercooled water is greater than ice. Replicas (*1*) were made of the crystals formed in the cloud, and the microscope showed them to be similar to those found in Nature on cold mornings and known as "diamond dust." The relative size of natural snow crystals is shown in Fig. 1. The smallest of the three crystals in the photomicrograph is a typical crystal of the diamond-dust variety; the largest is a typical hexagonal plate found in an ordinary snowstorm; while the third form occurs in cirrus clouds. Those shown in Fig. 2 are representative of crystals developed in the laboratory cold chamber in

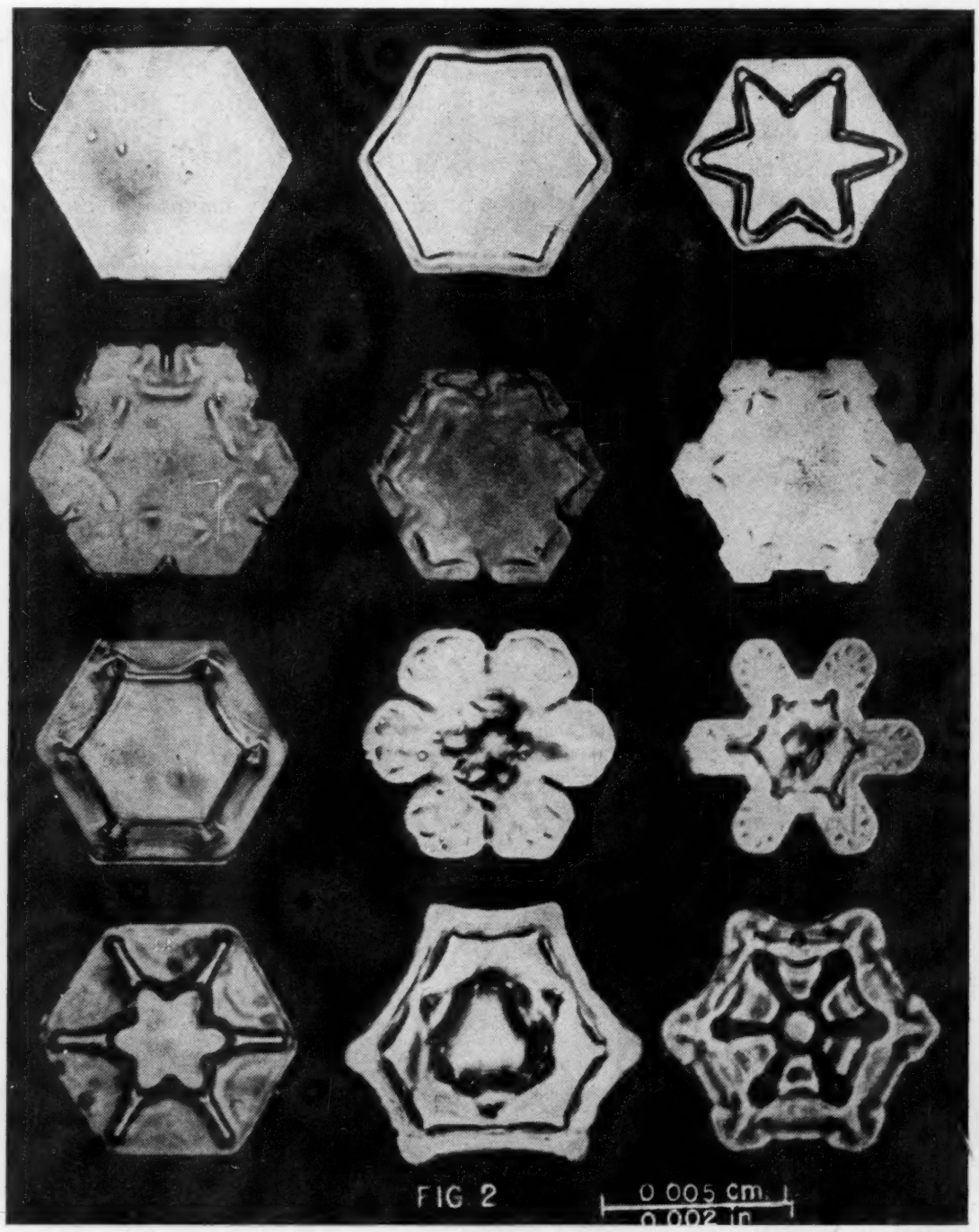

FIG. 2. Crystals formed in laboratory cold chamber.

about 4 minutes after a supercooled cloud was seeded. Besides using dry ice as a source of ice nuclei, a rod cooled in liquid air and passed rapidly through the supercooled cloud leaves a trail containing great numbers of submicroscopic nuclei which, due to microturbulence, spread through the cloud, causing it to dry up as the ice crystals grow. Subsequent experiments show that myriads of ice nuclei form spontaneously if a copper rod having a temperature of −35° C. is placed in a supercooled cloud having a temperature of −12° C. When replicas are made of the nuclei, which stream from the copper rod, they are found to have dimensions of less than 1 μ. Some of these tiny crystals show the trigonal symmetry of crystalline ice and are thin, triangular prisms.

Experiments are under way to investigate various aspects of this spontaneous development of ice crystals in order to determine whether relationships can be established between the laboratory experiments and the natural atmosphere.

It is planned to attempt in the near future a large-scale conversion of supercooled clouds in the atmosphere to ice crystal clouds, by scattering small fragments of dry ice into the cloud from a plane. It is believed that such an operation is practical and economically feasible and that extensive cloud systems can be modified in this way.

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Technical Papers

Ergosterol From the Mycelium of *Penicillium notatum* (Submerged Culture)

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The occurrence of ergosterol in the mycelia of molds has been known for some time, and its presence in the mycelia of various surface-cultured *Penicillia* has been recorded (*2, 4, 5*). Later, Whitmore, *et al.* (*6*) found ergosterol to be present in the mycelium of *P. notatum*. Cavallito (*3*) confirmed this and isolated it from the mycelia of *P. chrysogenum* and *P. citrinum*. The latter showed that in the mycelia of *P. notatum*, grown by submerged fermentation, traces of ergosterol could be detected spectrographically but not in quantities which could be isolated.

The present authors have studied the sterol fraction from a strain of *P. notatum* (X-1612) grown by submerged culture and have isolated and identified ergosterol by means of its physical characteristics and by those of the benzoate.

The residue resulting from the evaporation of an alcoholic extract of 2.88 kg. of air-dried mycelium (obtained from a production run) was extracted with ether. Concentration of the ether extract (after drying over sodium sulfate) gave an oil weighing 145 grams, which by photocolorimetric determination (*1*) showed an ergosterol content of 4.4 per cent; this was in agreement with ultraviolet absorption spectra data (Fig. 1). Saponification gave a crude sterol fraction weighing 8.58 grams and containing about 45 per cent ergosterol by both methods of determination. The absorption spectrum of this fraction is shown in Fig. 1.

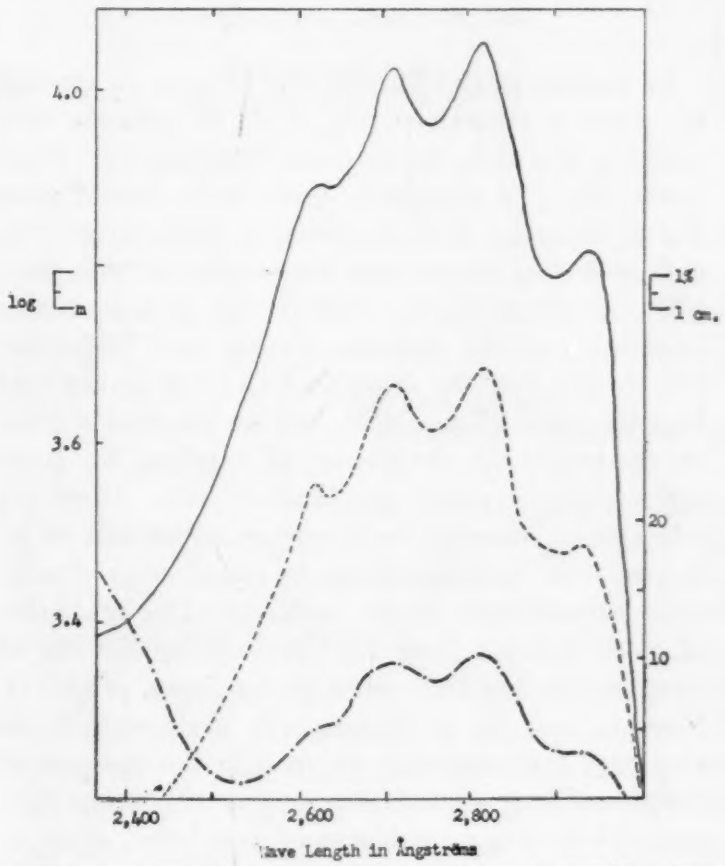

FIG. 1. Ultraviolet absorption curves of residue from alcohol-ether extracts, —·—·, calculated as $E^{1\%}_{1cm.}$; crude sterol fraction, - - - - -, calculated as E_m; purified ergosterol from mold, ———, calculated as E_m.

Recrystallization of the sterol fraction from alcohol-benzene (2:1) gave 4.52 grams of crude ergosterol—m.p., 124–133° C.—which, after further purification by fractional crystallization, yielded ergosterol

—m.p., 157.5–160° (corr.), not lowered by mixing with an authentic sample of ergosterol;[1] $[\alpha]^{25}_D$, −128.6; E_m, 11,160 (2,820 A.) (Fig. 1). The benzoate was prepared—m.p., 169.5–171° (corr.), not lowered when mixed with an authentic sample of ergosterol benzoate;[2] $[\alpha]^{25}_D$, −67.2.

Ergosterol has been detected in, and isolated in quantity from, the mycelium of *P. notatum* (X-1612) when the mold is grown in submerged culture.

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The Effect on the Chick Embryo of the Simultaneous Inoculation of Stool, Streptomycin, and Penicillin

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Developing chick embryos were used in an attempt to isolate a virus from the stools of patients with epidemic diarrhea, nausea, and vomiting (*6*) (viral dysentery). To attempt to decrease the loss of virus due to filtration and yet eliminate bacterial growth, unfiltered stool suspensions were combined with penicillin, streptomycin, or combinations of both before inoculation of the embryo. Parker and Diefendorf (*5*) showed that the injection into chick embryos of 50–1,300 units of penicillin had no observable effect on the growth of the viruses of vaccinia, St. Louis encephalitis, or equine encephalomyelitis. Hirst (*3*) was able to increase the frequency of growth of influenza virus in chick embryos by the addition of penicillin to unfiltered throat washings. The protection of chick embryos from fowl typhoid by the use of streptomycin has been described by Jones, *et al.* (*4*). Florman and his co-workers (*2*) demonstrated the ability of influenza virus to grow in the presence of streptomycin in concentrations up to 12,000 units per egg. There was no evidence of any lethal effect on the developing embryo. Reimann, *et al.* (*7*) have observed that in the human colon 600 μg. (units) of streptomycin per gram of feces may in some instances be sufficient to kill all the colon bacilli.

[1] The physical constants of ergosterol (hydrate) are: m.p., 160–163°; $[\alpha]^{20}_D$, −128.7 (K. C. Callow. *Biochem. J.*, 1931, **25**, 79); E_m, 11,500, (2,810 A.) (W. Huber, G. W. Ewing, and J. Kriger. *J. Amer. chem. Soc.*, 1945, **67**, 609).

[2] The physical constants of ergosterol benzoate are: m.p., 168–170°; $[\alpha]^{25}_D$, −70.5 (H. Wieland, and M. Assano. *Ann.*, 1929, **473**, 300).

Method

Thirteen- or 14-day-old developing chick embryos were inoculated, by the intra-amniotic method of Burnet (*1*), with 0.25–0.30 cc. of inoculum. The eggs were sealed with cellophane tape and incubated at 37° C. for approximately 40 hours. (This time was established during the early part of the study after noting the peak of the death rate of test and control eggs.)

Three different stool specimens were used: two which had been preserved on dry ice for 1–3 months, taken from persons suffering from epidemic diarrhea, nausea, and vomiting, and one fresh "normal" specimen. Ten-per cent suspensions of stool in broth were centrifuged at 1,500 r.p.m. for 10 minutes and the supernatant material collected for use as inoculum.

The solution of penicillin was prepared by dissolving the sodium salt in sterile physiologic saline to a final dilution of 25–200 units in 0.05 cc. Streptomycin hydrochloride was dissolved in sterile physiologic saline to make a solution containing 5,000 μg. (units)/0.05 cc.

TABLE 1

Group	Stool suspension (cc.)	Saline (cc.)	Penicillin (cc.)	Streptomycin (cc.)	No. eggs	Embryos		
						Living	Dead	Positive cultures
1	0.2	0.05	...	...	20	0	20	20
	...	0.25	...	...	20	14	6	3
2	0.2	...	0.05	...	20	2	18	20
	...	0.2	0.05	...	20	16	4	0
3	0.2	...	...	0.05	15	4	11	1
	...	0.2	...	0.05	15	7	8	0
4	0.2	...	0.05	0.05	20	10	10	1
	...	0.2	0.05	0.05	20	11	9	1

Penicillin: 0.05 cc. (25–200 units); streptomycin: 0.05 cc. (5,000 μg. or units); stool suspension: 0.2 cc. (10-per cent suspension).

Each inoculum containing stool suspension was allowed to stand at room temperature for 30–90 minutes before injection. A similar group of controls was performed, substituting sterile physiologic saline (0.2 cc.) for the stool suspension. The different types of inocula are outlined in Table 1.

After about 40 hours each egg was opened aseptically, the appearance of the embryo noted, and fluid removed for culture. This material from each egg was incubated in a tube of hormone broth for approximately 24 hours; then blood agar plates were inocu-

lated from each tube of broth. Special anaerobic culture methods were not attempted.

Results

The results are summarized in Table 1. Death of the embryos occurred in nearly all of the eggs which received stool suspension mixed with saline or with penicillin. These eggs usually were foul smelling, and the embryos often were in various stages of decomposition. Cultures from them were positive in every instance. In the control group inoculated with saline or penicillin, about two-thirds of the embryos survived and only 3 out of 40 had positive cultures, a contamination rate of about 7 per cent.

In contrast, half of the embryos survived in the eggs inoculated with stool suspension, streptomycin, and penicillin. Practically the same rate was obtained in the corresponding group of controls. About one-third survived when inoculated with stool suspension and streptomycin, a frequency below that of the control group. The number of positive cultures from all the eggs in these groups was about the same as the contamination rate in the controls.

Conclusions

By the described method, using streptomycin and penicillin in simultaneous inoculations of stool suspensions into chick embryos for the purpose of combating bacterial growth, this study suggests that the use of streptomycin and penicillin combined is of greatest value; streptomycin alone is probably inferior; and penicillin alone has no value.

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Prothrombin and Fibrinolysin

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It has been stated a number of times that fibrinolysin, derived from plasma, can activate prothrombin to thrombin in the absence of calcium ion (*2, 3*). That conclusion has an important bearing on our understanding of the blood-clotting mechanism. Consequently, we were prompted to perform a series of experiments concerning the action of fibrinolysin on prothrombin. As a result of our work we believe that the fundamental conclusion is erroneous. When proper precautions are taken to *eliminate prothrombin and thrombin* from fibrinolysin preparations, the latter do not activate prothrombin, clot oxalated plasma, or clot purified fibrinogen solutions.

Quite unexpectedly, however, a new reaction has been discovered. Fibrinolysin *destroys* prothrombin. While the destruction proceeds it is possible to demonstrate, by commonly used analytical methods, that the purified prothrombin first becomes less easily activated with thromboplastin and later becomes completely refractive. We call this less reactive prothrombin *paraprothrombin,* to convey the idea that it is a modification of native plasma prothrombin. The reaction can be illustrated as follows:

$$\text{Prothrombin} \xrightarrow{\text{Fibrinolysin}} \text{Paraprothrombin} \longrightarrow \text{Inert protein}$$

Although the water-insoluble, saline-soluble, fibrinolysin preparation contains more than one protein, there is no reason to suspect that a factor other than the plasma-derived fibrinolytic principle is involved.

Fibrinolysin does *not* inactivate thrombin.

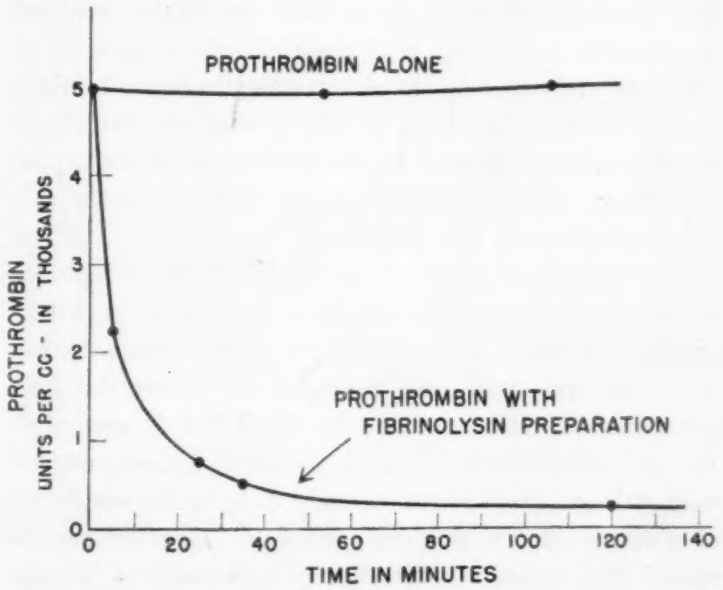

Fig. 1. The inactivation of purified prothrombin, at room temperature, with fibrinolysin.

Fig. 1 illustrates the rate of destruction of prothrombin by one of our potent lysin preparations. A 10,000-unit/ml. solution of purified prothrombin product No. 5 (*1*), dissolved in 0.9 per cent NaCl + 0.075 per cent $K_2C_2O_4 \cdot H_2O$, was mixed with an equal volume of fibrinolysin solution. The potency of the fibrinolysin solution was such that it would dissolve an equal volume of 0.3 per cent fibrin clot in less than 2 minutes. The disappearance of prothrombin was followed with the two-stage prothrombin titration technique (*4*).

The preparation of fibrinolysin and additional details will be described in another paper.

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Minimal Electroencephalographic Response to Metrazol as a Method for Measuring the Convulsive Threshold for Use in Human Beings

Eugene Ziskind, Henrikus Sjaardema, and Nicholas A. Bercel[1]

Cedars of Lebanon Hospital and *University of Southern California School of Medicine Los Angeles*

Measurement of the convulsant threshold by direct means (induction of seizures) has been performed, chiefly on animals. The harshness of the procedure precludes or limits its use in human beings. If a method were available to measure this response indirectly in man, it might have many practical applications. It therefore occurred to one of us (E. Z.) that perhaps the first, or at least an early, minimal response to the injection of a convulsant drug, such as metrazol, indicated by the electroencephalograph might be an indirect measure of the convulsive threshold. Dr. Sjaardema assisted in the electroencephalographic recordings and interpretations at first, but later this was continued by Dr. Bercel.

The method consists of the usual electroencephalographic recording. The subject is then given an intravenous injection of metrazol of given concentration at a uniform rate, and the time at which the first recognizable change occurs in the EEG is recorded. In the rabbit we have used the first appearance of high-voltage slow waves, usually a 1- to 2-second run of waves of 4–5 cycles per second of increased amplitude. This repeats itself shortly and tends to become "established" as a recurring paroxysmal episode of increasing frequency. The injection may or may not be continued on to the point of a convulsion.

The purpose of this communication is chiefly to record the method. However, certain observations have already been noted.

In our experiments with rabbits the minimal EEG response was always obtained, and always preceded the convulsion.

When the convulsive threshold was altered in rabbits as a result of drugs, the minimal EEG response was altered in the same direction. In rabbits, phenobarbital retarded the appearance of the minimal EEG response and of the convulsion. The following is an example of such a test run:

Injection of 0.5% Solution of Metrazol (1 cc./min.)

	Minimal EEG Response	Convulsion
Before phenobarbital	0.6 cc.	1.4 cc.
2½ hr. after phenobarbital	1.2 cc.	5.4 cc.

Phenobarbital: 50 mg./kg. by stomach tube

Dilantin did not have the anticipated effect of raising the convulsive threshold. At times a convulsion appeared more rapidly after the dilantin than before. However, the minimal EEG response also showed a lowered threshold. The following experiment is an example:

Injection of 1% Solution of Metrazol (1 cc./min.)

	Minimal EEG Response	Convulsion
Before dilantin	0.9 cc.	6.2 cc.
2 hr. after dilantin	0.5 cc.	2.3 cc.

Dilantin: 60 mg./kg. by stomach tube

Diluting the metrazol gave a rise in the convulsive threshold and also a rise in the threshold for the minimal EEG response.

Rabbit #68	Minimal EEG Response	Convulsion
1.0% metrazol solution	3.1 cc.	5.5 cc.
0.5% " "	6.1 cc.	15.8 cc.
0.25% " "	12.7 cc.	31.3 cc.

In a few patients who were tested the threshold for the minimal EEG response was raised by the administration of phenobarbital and dilantin. The following is an example:

Injection of 10% Solution of Metrazol (1 cc./min.)

Patient With Epilepsy	Minimal EEG Response
Without medication 11 hr.	0.4 cc.
Dilantin gr. iss. 5 and 2 hr. before	1.1 cc.

It may be concluded, therefore, that metrazol and possibly other convulsant drugs and other convulsive agents produce a minimal response on the EEG before the occurrence of the seizure. The data reported tend to support the thesis that this minimal EEG response fluctuates in the same direction as the convulsive threshold under different conditions of excitation.

[1] The authors are indebted to Bilhuber-Knoll Company for contributing the metrazol used in this study.

It is suggested that the minimal EEG response can therefore be used as a method for studying convulsive threshold in human beings, thereby avoiding drastic aspects of the seizures themselves.

Utility of Sulfa Drugs for the Inhibition of Mold Respiration in Grain [1]

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Division of Agricultural Biochemistry
University of Minnesota

Recent studies (*3*) have indicated that the carbon dioxide evolved from normal grain, held over time intervals of several days at moisture levels in hygroscopic equilibrium with air relative humidities in excess of 75 per cent, is due principally to the respiration of an indigenous mold population growing on the seeds. Under such conditions, the respiration of the seeds themselves is completely obscured. The respiratory activity of a freshly dampened seed sample increases continuously over time periods of several days and then tends to level off, the respiration-time curve thus assuming the form of a microbiological population-growth curve. On the other hand, at moisture levels in equilibrium with relative humidities below 75 per cent, where mold growth is not involved, seed respiration shows an extremely low and virtually constant rate with time.

With the object of obtaining data on the characteristics of true seed respiration at humidity values where it is normally obscured by mold respiration, a large number of organic compounds have been tested on wheat for fungistatic activity. The criterion of a suitable compound is that it must be fungistatic or fungicidal, but it must not adversely affect seed respiration or viability. Among the compounds which have been proposed for the suppression of mold respiration in grain are carbon tetrachloride (*2*) and trichloroethylene, quinosol, diacetyl, and phenothiazine (*1*). In the present studies search is being made for fungistatic compounds which are dry, relatively insoluble powders of low toxicity to animals and humans, and which would be odorless and tasteless. Among those investigated were 11 common sulfa drugs. Snow and Watts (*4*) have recently observed fungistatic activity by certain sulfa drugs when these were incorporated into nutrient agar media on which were cultured several mold species isolated from feeding stuffs.

TABLE 1

EFFECT OF SULFA DRUGS ON THE INCREASE OF ACIDITY DUE TO MOLD GROWTH ON REGENT WHEAT

Compound	Acidity*
Control	67.8
Sulfanilamide	22.6
Sulfapyridine	34.5
Sulfapyrazine	50.6
Sulfathiazole	33.3
Sulfaguanidine	52.2
Sulfadiazine	52.2
Sulfamerazine	53.8
Sulfaquinoxaline	50.1
Sulfasuxidine	29.6
Phthalyl sulfathiazole	56.3
Sulfamethazine	57.1

* Milligrams KOH required to neutralize benzene extract of 100 grams ground sample, air dry basis.

In the present studies the sulfonamides were finely ground and dusted onto the damp grain. Relative fungistatic activity was estimated from the increases in the acidity of benzene extracts of Regent wheat dampened with water to 20 per cent moisture (equilibrium relative humidity, 90 per cent) and stored for one month at room temperature. The results of this experiment are shown in Table 1. The effect of dry, powdered sulfanilamide in concentrations of from 1/2,000 to 1/250 (ratio of weight of sulfanilamide to weight of damp seed) on the respiration of Regent wheat containing 20 per cent moisture is shown in Fig. 1. Germination data for these wheat samples after the 11-day respiration trial are given in Table 2.

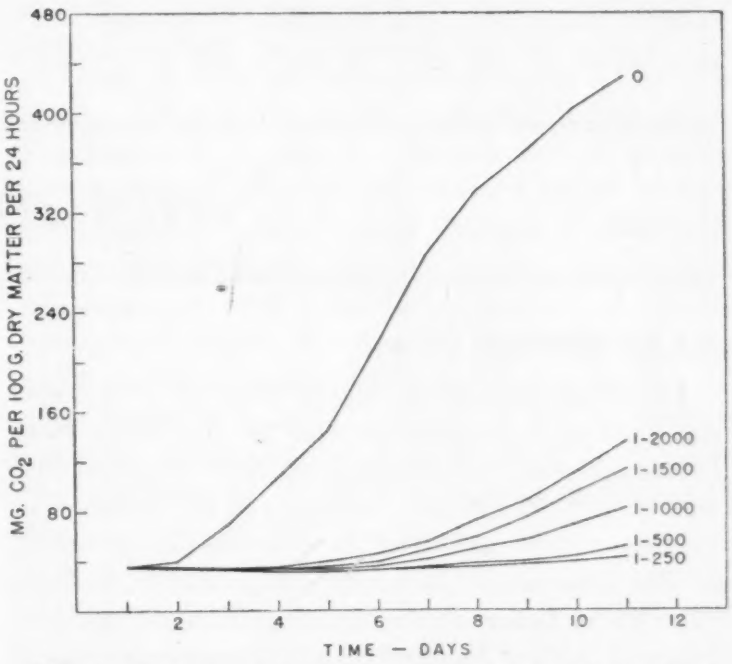

FIG. 1. Influence of various concentrations of powdered sulfanilamide on the respiratory behavior of wheat at 20 per cent moisture (relative humidity, 90 per cent).

Sulfanilamide showed the greatest fungistatic activity of the 11 sulfa drugs tested. It would appear that substitution in the amino group attached to the sulfonyl radical reduces the inhibitory effect of sulfa drugs toward the particular mold types which proliferate on wheat at this humidity level.

In the respiration trial the control sample showed respiratory increases analogous to the form of a

[1] Paper No. 2275, Scientific Journal Series, Minnesota Agricultural Experiment Station. This investigation was aided by a grant from Wallace and Tiernan Company, Inc., Newark, New Jersey.

microbiological growth curve, which is indicative of mold proliferation. Increasing concentrations of sulfanilamide increased the latent period of mold spore germination in proportion to the concentration of inhibitor used. It is significant that the respiratory rate of the control sample on the first day, before mold proliferation commenced, was the same as that of samples treated with sulfanilamide. This respiratory rate (about 33 mg. CO_2/100 grams dry matter/day) remained virtually constant for 8 days at the highest concentration of sulfanilamide and is probably representative of the true seed respiration under the conditions of moisture and temperature applied. Germination data (Table 2) indicate that suppression of mold growth by sulfanilamide yielded a larger percentage of viable seeds at the end of the trial.

TABLE 2

EFFECT OF SULFANILAMIDE ON WHEAT RESPIRATION AND ON THE MAINTENANCE OF WHEAT VIABILITY AT A MOISTURE VALUE FAVORABLE TO MOLD GROWTH*

Sulfanilamide concentration	Respiratory rate†	Germination (%)
0	428	10
1–2,000	136	57
1–1,500	114	62
1–1,000	83	69
1–500	52	82
1–250	43	84

* Wheat samples were tested for germination after 11 days in respirometers at 30° C., at a moisture value of 20 per cent. Initial germination was 94 per cent.

† Milligrams CO_2/100 grams dry matter/24 hours, on 11th day of trial.

Use of these findings is being made to determine the true respiration of wheat seeds with moisture contents as high as that required for germination. Investigation of the fungistatic effect of other organic compounds containing the sulfonamide radical is in progress. The utility of such compounds as a practical means to prevent the deterioration and heating of grain in storage is also under consideration. Results of these experiments will be published later.

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News and Notes

AAAS Meeting Notes

The Cambridge Entomological Club will hold a special meeting in conjunction with the AAAS meetings in Room B-455, Biological Laboratories, Harvard University, at 8:00 P.M. on Thursday, 26 December. The meeting will be addressed by Clarence H. Kennedy, of The Ohio State University, whose subject will be: "The Child Labor of the Termites Versus the Adult Labor of the Ant Society." An informal social gathering will follow. Visitors will be welcome.

The American Society of Parasitologists will meet in Boston in affiliation with the AAAS for a three-day program session, 26–28 December. The Statler Hotel will be the Society's official headquarters. The opening session on 26 December (2:00 P.M.) and the two sessions on 28 December (9:00 A.M., 2:00 P.M.) will be held there. Those for 27 December (9:00 A.M., 3:00 P.M.) are scheduled for Building EII, Harvard Medical School. The address of the retiring president, N. R. Stoll, on "This Wormy World," will be delivered at 11:00 A.M., 27 December. The annual luncheon and business meeting are scheduled at the Longwood Towers, Brookline, at 12:30 P.M., 27 December. The local representative of the Society is D. L. Augustine, Department of Comparative Pathology and Tropical Medicine, Harvard Medical School.

About People

Gregory Breit, professor of physics, University of Wisconsin, will become professor of physics at Yale University on 1 February 1947. Dr. Breit, a native of Russia, was National Research Council Fellow at Leiden in 1921–22 and at Harvard in 1922–23. He has served on the faculties of the University of Minnesota and New York University, and has been at the University of Wisconsin since 1934. He was resident of the Technische Hochschule in Zürich in 1928 and visiting member at the Institute for Advanced Study at Princeton in 1935–36.

Elaine Friedberg, a senior in The Ohio State University College of Pharmacy, received the Kilmer prize award, top honor for U. S. seniors in pharmacy, at the recent annual meeting of the American Pharmaceutical Association in Pittsburgh.

Victor Moritz Goldschmidt, professor of mineralogy and geology, University of Oslo, and head of the research laboratory on Mineral Raw Materials, Norwegian Ministry of Commerce, has returned to his work in Norway. He had been abroad since his arrest by the Nazis in 1942. Following his temporary release to continue his research on utilization of low-grade phosphate rocks he was again seized by the Nazis but

subsequently escaped to Britain through the aid of Norwegian patriots. While there he was made a scientific consultant to the Norwegian High Command. In connection with the Agricultural Research Council, he worked at the Macaulay Institute for Soil Research and at the Rothamsted Experimental Station. He also continued his work on the industrial use of olivine rocks for refractories, in cooperation with the Norwegian Ministry of Commerce and the Harbison-Walker Refractories Company, Pittsburgh. He was awarded the Wollaston Medal of the Geological Society for 1944. His health is now improving from the effects of the war years.

P. V. Cardon, administrator, Agricultural Research Administration, has been transferred at his own request to the position of special assistant to the chief, Bureau of Plant Industry, Soils and Agricultural Engineering. W. V. Lambert succeeds Mr. Cardon as research administrator.

Ernst Mayr, American Museum of Natural History, was awarded the Leidy Medal of the Academy of Natural Sciences, Philadelphia, on 2 October. The award is made once every three years for outstanding work in the natural sciences. Dr. Mayr is known for his research on the taxonomy and zoogeography of birds.

Roscoe R. Snapp has returned to his duties as professor of beef cattle, University of Illinois, after 57 months service in the Army, with the rank of colonel. Following the close of the war he was in charge of the work in animal husbandry at the G. I. University, Florence, Italy (see *Science,* 1946, **104**, 357–378). When that institution closed, he was with the Allied Command in Rome, directing the reorganization of the Agricultural Department of the Italian Government. Prior to his work with the G. I. University, he served with the Army in receiving rehabilitation supplies until that work was taken over by UNRRA.

Wing Cdr. K. C. Maclure, RCAF, received the Col. Thomas L. Thurlow Navigation Award at a meeting of the Institute of Navigation in Washington on 24 October. Cdr. Maclure's contributions to the science of navigation, the Institute's announcement said, include: a new system of measuring direction using the Greenwich Meridian as the datum, fixing position and the production of a polar astrograph, and a system of course checking by means of an astrocompass and polar astrograph. The award he received is a memorial to the late Col. Thurlow, U. S. Army navigation authority, inventor of the Fairchild A-10 sextant, the standard sextant for U. S. Army and Navy aerial navigators, and navigator on Howard Hughes' 1938 round-the-world flight. Cdr. Maclure was born in Montreal on 14 October 1914. In 1934 he was graduated from McGill University with a B.S.C. degree, obtaining first-class honors in mathematics and physics, and was awarded the Anne Molson gold medal for mathematics and natural philosophy. He was associate of the Actuarial Society of New York when commissioned as a navigation instructor in the RCAF in 1939. In November 1944 he became a member of the Empire Air Navigation School. While at this post he made many valuable contributions to the science of navigation, including work on consol and pressure pattern flying, and culminated his research in polar flying with his Greenwich Grid system of measuring direction and his participation in the Aries flights during 1945.

Ladislaus L. Marton has been appointed principal physicist in the Electronics Section, National Bureau of Standards. Dr. Marton was formerly associate professor of physics and headed the Division of Electron Optics at Stanford University. He will initiate a program of research on the basic theory, methods, and applications of electron and ion beam devices. The work will cover those phases of the program of the Electronics Section which involve the theory and application of scientific devices which fundamentally involve the directed flow of electron and ion beams. He will also teach a course in electron optics in the National Bureau of Standards Graduate School. Dr. Marton received his doctorate of science in 1924 from the University of Zürich, where he remained as a research associate until joining the staff at the University of Brussels as an associate professor in 1928. In 1938, Dr. Marton came to America, continuing his research in electron optics as a physicist with the RCA Manufacturing Company, Inc. In 1941 he went to Stanford.

H. C. R. Simons, known for his research work on pathogenic blood protozoa, is now in Switzerland in relatively good health, according to Walter Pilnik, Hammerstrasse 20, Zürich 8, Switzerland. In 1933 Prof. Simons, unable to return to his house in Düsseldorf, because of the Gestapo, fled to England, where he continued his research work in London and Cambridge. In 1937 he went to the Institut Pasteur, where he invented his technique in diagnosing blood protozoa by saponine-methylene blue and taurocholate methylene blue. In 1943 he was arrested by the Nazis but was liberated 48 hours before his execution by French partisans and was able to reach Switzerland. He now continues his abstracting work for *Biological Abstracts,* begun in France, and has improved his saponine-methylene blue method under not altogether favorable conditions, since Swiss regulations make it difficult for foreigners to accept paid work. His address is: Pension Plattenberg, Schönleinstrasse, Zürich.

Visitors From Abroad

C. B. Fawcett, University College, London, will be the representative of the British Association for the Advancement of Science at the AAAS meetings in Boston. Prof. Fawcett is to deliver an address on "The Numbers and Distribution of Mankind" on Monday evening, 30 December, at 8:15 P.M. in the Saunders Theatre, Harvard University. During his visit to the States, he will be accompanied by his wife. As previously announced (see *Science,* 1946, **103**, 651), he will assume his duties as visiting professor at Clark University Graduate School of Geography, Worcester, Massachusetts, on 1 February. From the last of December until that date Prof. Fawcett will be free to visit other universities.

Sir Henry Dale, London, England, delivered the 12th annual Hughlings Jackson Memorial Lecture of the Montreal Neurological Institute on 16 October. His subject was: "Chemical Transmission at Central Synapses."

Nikolaas Tinbergen, professor at the University of Leiden, arrived in this country on 13 November to give, at the invitation of several universities, a series of lectures on recent European progress in the field of animal psychology. His address will be: c/o Dr. E. Mayr, American Museum of Natural History, New York 24, New York.

Seven scientists were among the 23 internationally known scholars upon whom honorary doctorates were conferred at Princeton's 200th anniversary of the granting of its charter on 19 October. Those honored with the Doctor of Science degree were Niels Bohr, Danish physicist whose research was credited with making the atomic bomb possible; Sir Henry Hallett Dale, England, Nobel Prize winner in medicine; Sir Harold Hartley, chairman of the British European Airways, the International Executive Council, and the British National Committee of the World Power Conference; Michael Polańyi, Hungarian physicist; Linus C. Pauling, Department of Chemistry, California Institute of Technology; Cornelius B. Van Niel, The Netherlands, professor of microbiology, Stanford University; and Cyril N. H. Long, Department of Physiological Chemistry, Yale University.

Announcements

In order to coordinate assistance to the Zoological Station in Naples (see *Science,* 1946, **104**, 352) the National Research Council has established a committee consisting of D. W. Bronk (ex officio), E. G. Conklin, R. G. Harrison, E. B. Harvey, S. Hecht, L. H. Kleinholz, A. R. Moore, H. H. Plough, and E. Scharrer, chairman. The Station is in great need of publications, reprints, laboratory equipment, and apparatus. Under present arrangements income from table rents by American organizations is being used for these purposes. The cooperation of American biologists will be greatly welcomed by the committee in its efforts to assist the Naples Station in regaining its place as an international center of biological research. Also, food packages may be sent to the Station, c/o Dr. R. Dohrn, Stazione Zoologica, Villa Nazionale, Napoli, Italy, either directly or by ordering them through CARE (Cooperative for American Remittances to Europe), 50 Broad Street, New York 4, New York. The administration of the Station strives to provide meals from inadequate supplies in order to keep the staff together and to compensate for the inflationary reduction of salaries. The committee will be glad to provide information to individuals who may wish to avail themselves of the research facilities of the Station and intend to apply for the table subscribed to by the NRC. Inquiries should be directed to: E. Scharrer, Department of Anatomy, University of Colorado School of Medicine, Denver 7, Colorado.

The Graduate School of the U. S. Department of Agriculture, Washington, D. C., through its director, Lewis H. Rohrbaugh, has announced that it is sponsoring for the fall semester of its 26th academic year, a course entitled "Progress in the Field of Antibiotics." The course began on 24 September and consists of 15 weekly two-hour lectures designed to cover adequately the recent theoretical and practical advances in the study of antibiotics. Among the outstanding visiting lecturers who are participating in the course are: K. B. Raper, senior mycologist, Northern Regional Research Laboratory; Henry Welch, chief, Division of Penicillin Control and Immunology, Food and Drug Administration; Gordon O. Cragwall, director, Technical Service Department, Chas. Pfizer and Company; Robert D. Coghill, director of research, Abbott Laboratories; Rene J. Dubos, member, Rockefeller Institute for Medical Research; A. B. Crawford and J. O. Heishman, in charge, Animal Disease Station and Research in Mastitis of Cattle, respectively, Bureau of Animal Industry; O. K. Behrens, Biochemistry Department, Eli Lilly and Company; William J. Robbins, director, New York Botanical Garden; O. Wintersteiner, head, Division of Organic Chemistry, The Squibb Institute for Medical Research; S. A. Waksman, professor of microbiology, New Jersey State Agricultural Experiment Station; Karl Folkers, director of organic and biochemical research, Merck and Company; and C. S. Keefer, Evans Memorial Hospital. The course was organized and is being coordinated by H. T. Herrick and George W. Irving, Jr., Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture.

A staff reorganization of the Harvard College Observatory has brought about the appointment of two associate directors and the formation of a new advisory council, Dean Paul H. Buck, University provost, announced on 25 October. Bart J. Bok, who has served as associate professor of astronomy for 7 years, will become associate director under Harlow Shapley. Donald H. Menzel, professor of astrophysics and chairman of the Department of Astronomy, will become associate director for solar research. Members of the new advisory council are: Drs. Shapley, Menzel, and Bok; Cecilia Payne-Gaposchkin, Phillips astronomer; Fred L. Whipple and James G. Baker, associate professors of astronomy; and Walter O. Roberts, superintendent of the High Altitude Observatory of Harvard University and the University of Colorado, Climax, Colorado, and research associate. Matters of policy in regard to research, observations, and the accumulation of scientific data will be considered henceforth by the council. The staff reorganization, according to Dr. Shapley, director, has been made necessary by the growth of the 100-year-old observatory and the increased demands upon members of the staff.

Medical research in atmospheric environment and aviation medicine will be accelerated at the University of Illinois with the completion next summer of a new Physical Environment addition to the Research and Educational Hospitals at the Chicago Professional College Campus, Polk and Wood Streets.

A. C. Ivy, vice-president of the University, said that architects are now at work on final drawings for the new addition, a one-story structure with sufficient ceiling height to house large pressure- and temperature-controlled chambers, a large psychrometric room, and an acoustic laboratory.

Cost of the research addition will be $250,000. An additional expenditure of $250,000 will be made for the major portion of the research equipment which, because of its size, must be installed before the walls of the buildings are completed. Chief installations in the Physical Environment Building will be five pressure chambers—two for experimentation on humans and three for experimentation on animals. Dr. Ivy said.

One of the larger chambers will be cylindrical—7 feet 6 inches in diameter and 18 feet long. In it temperatures of 60° to 150° F. and simulated altitudes corresponding with heights 10 miles above sea level to depths as low as 200 feet below sea level can be created.

The second large chamber will be rectangular—$8 \times 10 \times 22$ feet. In it temperatures as low as $-60°$ F. and pressures comparable to those existing at altitudes as high as 50,000 feet above sea level and at depths as low as 30 feet below sea level can be created.

In the three animal chambers, all cylindrical and each 3 feet in diameter and 5 feet long, temperatures of 30° to 150° F. and pressures comparable to those existing at altitudes as high as 10 miles and depths as low as 200 feet below sea level can be created.

The building will be $21 \times 50 \times 156$ feet and will be constructed of steel and reinforced concrete with a brick exterior. The architectural contract has been let to Holabird and Root, Chicago architects. It is expected that construction contracts will be awarded early in 1947 and work started soon thereafter. The building will be completed in an estimated five or six months. E. P. Heckel, of E. P. Heckel and Associates, consulting mechanical engineers, Chicago, is working on the design of the chambers, psychrometric room, acoustic laboratory, and the mechanical equipment for controlling the temperature, pressure, and humidity in the various units.

The School of Mathematics, Institute for Advanced Study, will allocate a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and to do rsearch work at Princeton during the academic year 1947–48. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree. Blanks for applications may be obtained from the School of Mathematics, Institute for Advanced Study, Princeton, New Jersey, and are returnable by 1 February 1947.

The Department of Chemistry, Northwestern University, has announced that the seminar on "Magnetism and the Structure of Catalytically Active Solids," given earlier this fall by P. W. Selwood, will be repeated beginning 16 December 1946. The response to the first seminar was so great that all registrants could not be taken; however, there are vacancies available at this time for the second session. Topics to be included at the seminar are as follows: 16 December, "General Principles of Magnetochemistry"; 17 December, "Instrumentation"; 18 December, "Free Radicals and Complex Compounds"; 19 December, "Susceptibility Isotherms"; and 20 December "Curie Point Diagrams."

Each registrant will have an opportunity to make several measurements on a variety of catalytically active solids. Assistance will be given on the interpretation of the data obtained. Registrants are invited to bring their own samples for measurement, in addition to standard samples which will be provided, such as gamma-alumina, chromia-alumina, nickel-kieselguhr, copper chromite, etc. Those who wish to bring their own samples for measurement should com-

municate with Dr. Selwood in advance. The University will be provide housing, and the registration fee, including housing, is $125. Inquiries should be addressed to Prof. Robert K. Summerbell, chairman of the Chemistry Department, Northwestern University, Evanston, Illinois.

The Columbia Broadcasting System began a 13-week series of radio discussions on Tuesday, 12 November, 6:15–6:30 P. M., EST, on "You and Alcohol." The series will provide a more exhaustive survey than previous sporadic broadcasts have accorded this subject. To acquaint the public with facts about alcohol and circumstances arising from its use as a beverage, the series will deal with social, medical, religious, legal, psychological, physiological, and other aspects of the subject.

Keynoting the programs was the initial discussion, entitled "A National Problem," by E. M. Jellinek, biometrician and director of the Section on Alcohol Studies of the Laboratory of Applied Physiology, Yale, and director of the Yale Summer School of Alcohol Studies.

Scheduled for the second and third broadcasts, 19 and 26 November, are, respectively, Henry W. Newman, Stanford University Medical School, on "Alcohol and the Human Body"; and Carney Landis, professor of psychology, Columbia University, and principal research psychologist, New York State Psychiatric Institute and Hospital.

Among other speakers scheduled for broadcasts in the "You and Alcohol" series are: Lyman Duryea, medical director of the National Research Council's Committee on Problems of Alcohol; Selden D. Bacon, Department of Sociology, Yale University; and John Riley, professor of sociology, Rutgers University. Other participants in the series are to be announced later.

Meetings

The Northwest Scientific Association will hold its next annual meeting at Spokane, Washington, on 27–28 December 1946, with R. F. Daubenmire, Department of Botany, State College of Washington, as program chairman. Officers for the present year are: H. T. Gisborne, Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana, president; J. G. McGivern, dean, College of Engineering, Gonzaga University, Spokane, vice-president; and G. O. Baker, Department of Agronomy, University of Idaho, Moscow, secretary-treasurer. Section chairmen are: Bacteriology and Public Health, H. W. Lundy, State Department of Health, Seattle; Botany-Zoology, R. A. Dietert, Montana State University, Missoula; Chemistry-Physics-Mathematics, T. O'Leary, S. J., Gonzaga University; Engineering, Henry Gauss, University of Idaho; Forestry, K. P. Davis, Montana State University; Geology-Geography, Phil E. Church, University of Washington, Seattle; Social Science, E. Tascher, Montana State University; and Soil Conservation, J. L. Schwendiman, Soil Conservation Service, Pullman, Washington.

The Advisory Council for the Mooseheart Laboratory for Child Research will meet at Mooseheart, Illinois, on 29–30 November and 1 December. The members of the Council are: John E. Anderson, director, Institute of Child Welfare, University of Minnesota; Allan G. Brodie, head, Department of Orthodontia, University of Illinois College of Dentistry; E. W. Burgess, professor of sociology, A. J. Carlson, professor emeritus of physiology, Wilton Marion Krogman, professor of anatomy and physical anthropology, Carl R. Rogers, professor of psychology, and R. W. Tyler, chairman, Department of Education, all of the University of Chicago; H. F. Helmholz, Section of Pediatrics, Mayo Clinic; Ernest Horn, College of Education, University of Iowa; R. L. Jenkins, Department of Psychiatry, University of Illinois; C. A. Prosser, director, William Hood Dunwoody Institute, Minneapolis; and Louise Stanley, special assistant to the research administrator, U. S. Department of Agriculture.

Recent Deaths

Arthur Emanuel Hertzler, 76, professor of surgery at the University of Kansas Medical School for many years, died on 12 September. "He was the first to show that the fibrous tissue of the body is not a secretion of the connective tissue cells," as was formerly believed.

Franklin Bache, 77, great-great-great-grandson of Benjamin Franklin, and long an active member of the Franklin Institute, died on 17 September. Until his retirement 20 years ago, he was associated with coal mining companies.

Harris Perley Gould, 75, horticulturist and authority on fruit and vegetable research, died in Washington, D. C., on 17 October. Mr. Gould, who retired in July 1941 from the Department of Agriculture where he was head of the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, had served with the Department since 1 July 1901.

Melvin Dresbach, 72, professor of physiology and pharmacology, Hahnemann Medical College, and formerly professor of physiology, Albany Medical College, died on 16 October.

Wilbur B. Rayton, 61, optical enginer and director of the Scientific Bureau of Bausch & Lomb Optical

Company, died on 31 October while attending meetings of the Society of Motion Picture Engineers in San Francisco.

John Hillyer White, 66, a metallurgist with the New York Laboratories of the Bell Telephone Company for 30 years, died on 30 October.

Albert Sherman Eastman, 64, head of the Chemistry Department, University of Delaware, for 20 years, died on 4 November.

Charles S. Myers, 73, British psychologist, died on 12 October. Dr. Myers was a member of an expedition in 1898 to study the vanishing culture of the natives of the Torres Straits region. Prof. H. J. Fleure states in *The Times,* London, that: "The idea of that expedition was inspired by a vision of the unity of the sciences studying mankind socially, psychologically, and physically in the past as well as in the present. . . . Myers came back to use his experience in studying his fellow citizens in Britain, and on this basis he built up his valuable work on the guidance of young people in the choice of occupation and on industrial psychology generally." A few days before Dr. Myers' death, the National Institute of Industrial Psychology, which he had founded and of which he had served as head, celebrated its 25th anniversary. Upon this occasion, Sir Stafford Cripps stated that occupational psychology has become "the very core of our problem of production."

Letters to the Editor

Progressive Evolution

Doubt has been expressed by Aldous Huxley as to whether progress has really been of any advantage to mankind. If it isn't good for us, we want none of it, but change is inevitable, and if we don't want progressive change, we are sure to get something else which may not be any better for us. So let us inquire what we mean by progress before we throw it into the discard. Human evolution, as Julian Huxley has emphasized, is actually going on at a greatly accelerated pace in our time. We have become "consciously evolutionary," but where do we think we are going?

Evolution implies change, which may be either progressive or regressive. Progressive organic evolution may be defined as change in the direction of increase in the range and variety of adjustments of the organism to its environment. This involves increase in the complexity of structure, ensuring sensitivity to a greater variety of environing energies and more refined sensory analysis, elaboration of more varied and efficient organs of response, and more complicated apparatus of central control (nervous, vascular, endocrine, etc.). In the case of the reproductive functions, increase in complexity is in general correlated with the preceding changes in adaptation to diverse modes of life.

These progressive evolutionary changes are primarily in the interest of the individual organism—its survival and enlargement of the range of its activities, with more varied needs and satisfactions. The adaptation of a species as a whole to some particular niche of the environment may or may not be progressive; in the case of many parasites, for instance, it is regressive.

In the human realm these biological factors are operative, but they are in large measure subordinated to psychological factors of different order. Human evolution is essentially social evolution, and increasingly so. Both survival and satisfaction depend upon an efficient social organization which can be intentionally controlled. Under present conditions in a high culture this control must be by voluntary consent of a majority of the people. Control enforced by tyrannical power is unstable, and it results always in regression. Progress in this realm demands cooperative association with voluntary renunciation of some personal and group advantage and sovereignty. Our needs and desires have grown out of bounds and can be satisfied only by working harmoniously with others for mutual benefits or in lawfully ordered competitive enterprises.

At the moment we seem to be in a back-eddy of reversion to bestial standards of selfish concern for personal, group, and national advantage in disregard of social welfare and stability. This can be changed if enough of us want to and are willing to pay the price. It is fortunate that under the surface of our present disorder there is, as there always has been, a strong human craving for decency, justice, and social stability based on individual responsibility for the welfare of the group, and the group has now been enlarged to include the whole world. This key to social progress has not been lost, and it is up to all of us to recognize it and use it.

C. Judson Herrick
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Addendum to "Cytoplasmic Diseases and Cancer"

Since the appearance of our report (*Science,* 1945, 102, 591), articles written by Graffi (*Z. Krebsf.,* 1939, 49, 477; 1940, 50, 196, 501) came to our attention. In these articles Graffi developed a theory on the derivation of viruses from mitochondria (cf. Graffi's extensive and valuable literature review) and the possible role of mutated mitochondria in the causation of neoplastic diseases, which is almost identical with the views expressed by us. Graffi developed these theories on the basis of a study in which he demonstrated that certain fluorescent carcinogens, as benzopyrene, are absorbed specifically on

the mitochondria of animal cells. We came to the same theoretical conclusions as Graffi but from an entirely different approach, in that, in our studies, we were able to show that in plants modified mitochondria (plastids) induce diseases that are fundamentally like those induced by plant viruses. Also, on the basis of chemical and physiological observations, we were led to the concept that certain viruses have evolved from mitochondria or their constituents, implying that similarly modified mitochondria of animal origin can reasonably be expected to be disease causing and that these diseases might be represented by the neoplastic diseases. It is interesting to note that two entirely independent groups of research workers arrived at identical concepts although starting from different points. We regret that our oversight has prevented us from giving due credit to the considerations of Graffi, who terminates his article with the following sentence, which we translate:

"May it however once more especially be emphasized that at the present these trains of thought are still purely speculative and that they have already partially been expressed by other authors in one way or another. However, it might pay to follow them experimentally in one case or another."

MARK W. WOODS
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H. G. DUBUY
Industrial Hygiene Research Laboratory
National Institute of Health, Bethesda, Maryland

A Note on "Radioactive Hydrocarbons"

In a letter describing the synthesis of mesitylene from radiocarbon dioxide by A. V. Grosse and S. Weinhouse (*Science*, 1946, **104**, 402), an error in representation has been introduced which may be very misleading to those inexperienced in the use of isotopic materials in the synthesis of organic substances.

The two cyclic products obtained, namely, mesitylene and the corresponding trimethyl cyclohexane, must be labeled with Carbon 14 in all three positions in the ring on the carbons bearing the methyl groups. The mixing of inactive acetone with the carbonyl-labeled acetone in Step 4 merely accomplishes a dilution of the resulting activity.

M. CALVIN
Radiation Laboratory, University of California

A Designation for Micronutrients

In a letter entitled "Quantification of Micronutrients" (*Science*, 1946, **104**, 303), Harold N. Simpson recommends that the micronutrients (vitamins and trace minerals) be reported in micrograms per gram.

I have found this designation to be undesirable for the following reasons: The technician making up rations does not ordinarily actually weigh in micrograms and must recalculate to some practical unit, usually milligrams. It is surprising how frequently an error can be made in this process. Furthermore, the term "microgram" is difficult to visualize as a definite quantity, but everyone knows approximately what a "milligram" looks like.

For this reason I have found the most suitable designation for micronutrients to be "milligrams per kilogram." Quantities so expressed can be stated interchangeably as "mg. per kilo." or as "ppm."

A. R. PATTON
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Reprint Filing—Perennial Problem

L. R. Richardson recently described a system of filing reprints alphabetically by author (*Science*, 1946, 104, 181). He uses manila envelopes for the reprints of each author, and a cross-reference by subject is maintained on index cards. Richardson also quoted Smith (*Guide to the literature of the zoological sciences.* Burgess Publishing Co., 1943), who advocated filing all reprints numerically as received. With this latter method a card index for both subject and author must be maintained—a distinct disadvantage to those not having secretarial help—and, as Richardson points out, it is an unnatural method. An objection to filing by author is that, unless the author's name is remembered, the subject index card must first be consulted. Considerable time is also involved in extracting from the file several papers on the same subject unless they happen to be by the same author.

Although the filing system to be described may not be suited to all subjects or to special cases, it has been found very satisfactory for the subject of pharmacology (including papers on the closely related biological sciences) and should be adaptable to many other fields. The reprints are filed by subject and are given code numbers analogous to the Dewey decimal system used by libraries. An author index is maintained on index cards. A few examples will be given to illustrate how the system is applied.

The subjects were first separated into several classes of code numbers. Numbers 00. to 09. include all papers dealing with drugs acting on the central nervous system; numbers 10. to 19., those dealing with the autonomic nervous system; 20. to 29., those dealing with circulation; and so on to 90. to 99., which is a miscellaneous classification.

Within the classes individual subjects were assigned code numbers. For example, number 00. represents analeptics and convulsants; number 01., centrally acting nonopiate analgesics; 02., the general anesthetics; and so on.

Occasionally it was found that the use of subgroups was necessary. For example, the subject of vitamins was assigned to the 60.–69. class. Group 61. contains general papers on vitamin B, while number 61.1. is for papers on thiamine; 61.2., papers on riboflavin; 61.3., papers on pyridoxine; etc.

Individual reprints under each subject are numbered serially as received. The code and serial numbers are combined and placed in the upper right-hand corner in red ink; thus, for example, 02.1, 02.2, 02.3, etc., or, as with subgroups, 61.1.1, 61.1.2, 61.1.3, etc.

The same numbers are also placed on the author index cards, which contain only the author's name, the title

of the paper, and the code number. It would also be advisable to put the code number on any abstracts made of the reprints. However, doing this may add a bit of extra work, since abstracts are often made from the original article before a reprint is obtained and catalogued. Although I have not found it necessary, it is suggested that if any group becomes overburdened with reprints, the titles be listed numerically on a sheet inserted at the beginning of the group. If the group becomes still bigger, a subject card index file could be set up as suggested by Richardson.

Instead of envelopes for holding the reprints I have been using pamphlet boxes, 7 inches wide × 10 inches high × 3½ inches deep. When necessary, reprints are trimmed to 7 inches × 9½ inches, or those too large to be trimmed are folded. Trimming or folding has not been found a serious handicap, since only about one-fourth are too large for this size of box. Spacer cards with index tabs giving the subject and code number separate the different groups of reprints. If the boxes are kept at a minimum of three-quarters full, there is little more waste space than that represented by the thickness of envelopes, especially when the envelopes may hold in many cases no more than a single reprint. If envelopes were used for filing by subject, there would be, at least in most fields, far fewer needed than in filing by author.

When a box becomes full, the rear group of reprints is transferred to the next box, and a similar shift is made in successive boxes. In a rapidly growing collection new boxes should be inserted at intervals. The effort in making such a rearrangement from time to time is minimal. A card on the outside of each box gives the code number and subject of each group in the box. The card is slipped into a shallow pocket made by pasting a cut envelope on the outside of the box. The code numbers and subjects are visible above the edge of the pocket.

In setting up the system some thought should be given both to the classes of subject matter and to the group titles. As I have employed the system, nearly every class has some unused group code numbers which are available for future expansion. With the use of subgroups expansion of the filing system is virtually unlimited.

R. H. K. FOSTER

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St. Louis University School of Medicine

Book Reviews

Acetanilid: a critical bibliographic review. Martin Gross. New Haven: Hillhouse Press, 1946. Pp. 155. $3.00.

This review of acetanilid is the first of a series of monographs from the Institute for the Study of Analgesic and Sedative Drugs. It is introduced by H. W. Haggard, director of the Laboratory of Applied Physiology, Yale University, and will be followed by other volumes under the same editorship dealing with salicylates, phenacetin, bromides, and antipyrine. Not only are these intended to furnish for investigators a critical review of the whole literature, but they also collect and evaluate the previous and encourage additional research.

The present work is an excellent survey of the problems which have been studied by biochemists, pharmacologists, and clinicians since acetanilid (antifebrin) was introduced in 1886 by Cahn and Hepp as the first modern antipyretic. The material is discussed in several meticulously elaborated chapters. The most important are: "The Fate of Acetanilid in the Body," "Therapeutic Use," "Pharmacology and Toxicology With So-called Cases of Acetanilid-Poisoning," and "The Question of Addiction or Habituation." Pharmacologists and clinicians will find in all these chapters that, despite 60 years of experimental and practical research, a wide field is still open for new investigations to confirm and augment older studies and to ascertain new facts about the antipyretic, analgesic, and toxic action of this drug, so fundamental to our knowledge of all antipyretics subsequently discovered. Its excellent and critical contents are supported by an extensive bibliography of 763 references.

All scientists interested in the progress of experimental or clinical therapy will find stimulating material for study in this outstanding volume, which is highly recommended.

ERNEST P. PICK

Laboratories of the Mount Sinai Hospital, New York City

The dynamics of human adjustment. Percival M. Symonds. New York: D. Appleton-Century, 1946. Pp. xiv + 666. $5.00.

This book gives evidence of the increasing interest in dynamic psychology, which the author defines as "concerned with the ways in which an individual satisfies his inner drives from the physical and social world in which he lives." The scope and level of the volume show that it is intended primarily as a textbook for advanced students who are preparing for professional work in clinical psychology.

The six opening chapters deal with general principles of dynamic psychology. The thesis of these chapters is that the frustration of human drives leads to aggression, that aggression meets with punishment, that punishment is the source of anxiety, and that anxiety, in turn, is the basis of substitutive and neurotic behavior. The seventh chapter, on defenses against anxiety, is a transition to the core of the book, which discusses at length each of the mechanisms of adjustment, including fixation, regression, repression, displacement, introjection, projection, identification, sublimation, reaction and reversal formation, compensation, rationalization, and fantasy.

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There is a final chapter on the criteria of normality. It may be regretted that the author did not add a systematic presentation of psychotherapy, although therapeutic considerations are included in a number of the chapters on the mechanisms. The bibliography of 883 items is unusually complete and accurate, and includes brief commentaries on almost all of the references.

Most of the material in the introductory chapters is compatible with the trend of eclectic American psychology, based on physiological and experimental concepts and evidence. The chapters on the mechanisms are, as the Preface states, "frankly psychoanalytical" in point of view. In many instances the objective and psychoanalytic approaches have been blended harmoniously, but in others the reconciliation has not been accomplished successfully, with the result that contradictory statements sometimes occur in close proximity. For example, page 138 says: "Anxiety is learned. . . . Since anxiety is a response to the anticipation of danger, it must have been learned from the actual situation of danger. . . ." Page 140 states: "Anxiety puts in its first appearance at birth and is evidenced by the infant's first spasmodic efforts to catch its breath and to utter its first wail." Contradictions such as these are but the growing pains of an immature but vigorous area of investigation. In spite of them, the clinical and analytical material is of value as a storehouse of hypotheses that, in time, will be drawn into the structure of scientific psychology.

Symonds' book is a worthwhile contribution to progress in the merger of psychology and psychoanalysis.

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pH and plants: an introduction for beginners. **James Small. New York: D. Van Nostrand, 1946. Pp. vii + 216. (Illustrated.) $4.00.**

Considering that "many biological reactions tend to vary as the logarithm of the hydrogen-ion concentration or activity," the author has assembled from "the literature, now immense . . . samples over a wide field to illustrate methods of approach and type of results." Abstracts or summaries of numerous research papers are more or less loosely grouped together in chapters on pH in relation to plant sap, cell walls, protoplast, plant enzymes, aquatic life, plant pathology, and succulents.

In a chapter on "Soil pH and Plants" selected species are assigned to a series of classes termed "acidiphilous, acid-tolerant, amphi-tolerant, mesophilous, alka-tolerant, and alkaliphilous." The distinction of presumed "phily" from tolerance is based, however, merely on slight numerical differences in reported pH ranges.

There is a bibliography of some 300 titles, on the whole well selected, although one misses the names of Åslander, whose studies of the antagonism of hydrogen by other ions are of considerable interest. No clear-cut logical treatment with concise conclusions or summaries of the results obtained in the various fields is given, but a 17-page index makes possible the location of many scattered items.

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Scientific Book Register

BEDINGTON, H. M. (Compiler.) *Some British books on agriculture, nutrition, forestry, and related sciences, 1939–1945.* (Imperial Agricultural Bureaux Joint Publication No. 11.) Penglais, Aberystwyth, Great Britain: Imperial Agricultural Bureaux, 1946. Pp. v + 37. 3s.

BRILLOUIN, LEON. *Wave propagation in periodic structures: electric filters and crystal lattices.* New York-London: McGraw-Hill, 1946. Pp. xii + 247. (Illustrated.) $4.00.

ELLIOTT, STANLEY B. *The alkaline-earth and heavy-metal soaps.* New York: Reinhold, 1946. Pp. x + 342. (Illustrated.) $7.50.

ENGLE, EARL T. (Ed.) *Proceedings: Conference on Diagnosis in Sterility.* Springfield, Ill.: Charles C. Thomas, 1946. Pp. xi + 237. (Illustrated.) $5.00.

GILMORE, CHARLES W. *A new carnivorous dinosaur from the Lance formation of Montana.* (Smithsonian Miscellaneous Collections, Vol. 106, No. 13.) Washington, D. C.: Smithsonian Institution, 1946. Pp. 19. (Illustrated.)

HEWITT, RICHARD M., NEVLING, A. B., ECKMAN, JAMES R., and SMITH, M. KATHERINE. (Eds.) *Collected papers of the Mayo Clinic and the Mayo Foundation.* Philadelphia–London: W. B. Saunders, 1946. Pp. ix + 899. (Illustrated.) $11.00.

LEITHAUSER, DANIEL J. *Early ambulation and related procedures in surgical management.* Springfield, Ill.: Charles C. Thomas, 1946. Pp. vi + 232. (Illustrated.) $4.50.

OPPENHEIMER, JAMES M. *New aspects of John and William Hunter.* New York: Henry Schuman, 1946. Pp. xviii + 188. $6.00.

POLYAK, STEPHEN L., MCHUGH, GLADYS, and JUDD, DELBERT K. *The human ear in anatomical transparencies.* (Published under the auspices of Sonotone Corporation.) New York: T. H. McKenna, 1946. Pp. 136. (Illustrated.) $10.50.

SKRODER, CARL E., and HELM, M. STANLEY. *Circuit analysis by laboratory methods.* New York: Prentice-Hall, 1946. Pp. xvi + 288. (Illustrated.) $5.35.

WORRALL, R. L. *The outlook of science—modern materialism.* New York-Toronto-London: Staples Press, 1946. Pp. 187. 12/6d.

ZOETHOUT, WILLIAM D., and TUTTLE, W. W. *Textbook of physiology.* (9th ed.) St. Louis: C. V. Mosby, 1946. Pp. 723.

———. *Nucleonics.* Washington, D. C.: Progress Press, 1946. Pp. 38. (Illustrated.) $1.00.

———. *What industry owes to chemical science—a symposium.* (1st Amer. ed., based on a scheme by Richard B. Pilcher and Frank Butler-Jones, with 50 contributors.) Brooklyn, N. Y.: Chemical Publishing Co., 1946. Pp. viii + 372. $5.00.